WARNING

Because of possible shock or fire hazards, connection of this instrument should be performed in compliance with the National Electric Code (ANSI C1) or any other requirements, or both, which may be applicable to the user.

Installation, operation, and maintenance should only be performed by qualified personnel.

TM-112975-G3/G4-1

VOLUME 1 -- OPERATOR'S MANUAL

626-PA-6040

400 HERTZ THREE-PHASE AC GRAPHICS MONITOR

1 August 1988
(Rev. 1 Sept. 1989)
(Rev. B)

See opposite side relative to proprietary rights.

Note: Refer to Volume 2 (Service Manual) of TM-112975-G3/G4 for maintenance information.

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DRANETZ TECHNOLOGIES, INC.
1000 New Durham Road
Edison, New Jersey 08818

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- Epson FX-100+ was developed by Epson America, Inc.
- H.P. Thinkjet was developed by Hewlett-Packard Co.

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VOLUME 1
OPERATOR'S MANUAL

626-PA-6040
400 HERTZ THREE-PHASE AC GRAPHICS MONITOR

SECTION I
GENERAL INFORMATION

1.1 SCOPE

The manual for this product consists of two volumes. Volume 1, the Operator's manual, is divided into three sections: (I) GENERAL INFORMATION, (II) INSTALLATION AND OPERATION, and (III) OPERATIONAL TEST. Volume 2, the Service manual, contains the maintenance instructions and consists of four sections, IV through VII. (See Volume 2 for a description of these sections.)

1.2 INTRODUCTION

Volume 1 of this manual provides Operator's instructions for the 626-PA-6040: 400 Hertz, Three-Phase AC Graphics Monitor plug-in module. For simplicity, the module will be referred to as a 6040 plug-in from this point on with any differences in operation noted. Before reading these instructions further, you should be familiar with the Mainframe information described in your Series 626 Mainframe manual.

There are two models of the 6040 plug-in: Model 626-PA-6040-1 and Model 626-PA-6040-2. Model 626-PA-6040-1 has barrier-type terminal strip inputs while Model 626-PA-6040-2 has connector inputs and mating cables. This manual is applicable to both models. Any differences in installation are noted in the text.

1.3 PURPOSE

The 6040 plug-in monitors disturbances (impulses, sags, surges, undervoltages, overvoltages, and frequency variations) on 3-phase ac power lines with 400 Hz nominal frequency. Each phase is monitored on a single voltage range of 0 to 600V rms and a single impulse range of 50 to 4000V pk. With user-programmable thresholds, the 6040 plug-in monitors both short- and long-term power line disturbances.

Using this plug-in, the Mainframe is able to store, analyze, classify, and print quantitative disturbance data. Printouts include the time and date derived from a highly accurate 24-hour clock built into the Mainframe.

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NOTE

When the Series 626 Mainframe is equipped with a Model 626GP Graphics Printer, Epson FX-100+, or H.P. Thinkjet, graphical disturbance data can be printed in addition to the text. (Graphical data is often easier to interpret than text.)

1.3.1 Three-Phase Monitoring

The plug-in monitors any 3-phase power line with rms (root mean square) values ranging from 0 to 600 volts. Three types of disturbances are monitored by the 6040 plug-in: power line frequency, voltage transients, and waveform disturbances.

-- Voltage transients are divided into five display categories:

(1) Overvoltage
(2) Undervoltage
(3) Voltage Change
(4) Voltage Surge
(5) Voltage Sag

-- Waveform disturbances, identified as "impulses" or "spikes," include all conditions that cause the power line waveform to deviate from an ideal waveform. The 6040 plug-in measures the peak amplitude of impulses and their duration. Voltage and frequency thresholds are user-programmable and threshold settings are common to all three line phases. Disturbance data is normally printed whenever a disturbance occurs and also at the end of each day. In the Program Summary mode, however, a disturbance data summary is only printed at the end of each day. (This feature permits long-term unattended operation.)

1.3.2 Threshold Programming

The threshold program can be changed using the front panel buttons, keys, and switches. Cueing LED indicators adjacent to the programming keys simplify the programming procedure. A back-up preset program for the plug-in, stored in permanent memory at Dranetz, can be recalled if needed. Both the program and the disturbance data in the data accumulators can be printed upon demand.

NOTE

Frequency measurements are derived from phase A only, therefore, if you are performing single-phase monitoring, always use phase A.

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1.4 APPLICATIONS

When installed in the Series 626 Mainframe, the 6040 plug-in monitors and evaluates power system performance. Among its typical applications are the following:

a. Determining the effect of power systems operation on equipment malfunction. The 6040 plug-in allows rapid correlation of power line faults according to errors, outages, and equipment damage in computers, industrial process controls, digital communications equipment, medical monitoring apparatus, and so forth. Correlation is derived by a time-referred fault disturbance record produced by the 6040 plug-in and printed by either the Mainframe's printer or an attached graphics printer.

b. Performing pre-installation site surveys. The 6040 plug-in can be used to determine the adequacy of existing power lines that are intended to support critical electrical equipment.

c. Diagnostic evaluation of power system performance. The portability of the 6040 plug-in in a Mainframe makes it well suited for field use, and it is thus ideal for determining the probable causes of, and remedies for, power line disturbances.

d. Monitoring life test racks. The printouts produced by the 6040 plug-in (via the Series 626 or Graphics Printer) provide a clear record of the quality of power supplied during unattended operation.

1.5 EQUIPMENT CHARACTERISTICS

The 6040 plug-in is configured as a plug-in module 6-1/2" high by 2-1/2" wide by 10" deep. It is designed for installation into two adjacent slots in the Mainframe. Technical specifications for the plug-in are presented in Table 1-1.

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Table 1-1. 626-PA-6040 Technical Specifications (Page 1 of 2)

FUNCTION:	Monitor and graphically record impulses, sags, surges, undervoltages, overvoltages, and frequency variations on three channels of ac voltage.
VOLTAGE INPUT:	2-wire differential Z_{in} = 20 Megohms plus 80 pF (each side to ground)
LINE VOLTAGE MEASUREMENT:	
Range -	50 to 600V rms
Resolution -	0.2V rms
Accuracy -	±1% of reading ±0.2% of F.S. (75 to 600V)
LINE FREQUENCY:	
Range -	370 to 450 Hz
Resolution -	±0.1 Hz
Accuracy -	±0.1 Hz
IMPULSE VOLTAGE MEASUREMENT:	
Range -	50 to 4000V pk (1 to 100 uSec)
Resolution -	1V pk
Accuracy -	For 100V to 4000V: ±10% of reading ±1% of F.S. (5 uSec to 25 uSec.) (Decreasing to ±6 dB at 1 uSec and 100 uSec.)
IMPULSE DURATION RANGE:	1 to 100 uSec
IMPULSE DURATION RESOLUTION:	1 uSec
SAMPLING TECHNIQUE:	8 kHz fundamental sampling rate overlapped with high speed peak impulse detection (from 1 uSec to 2 mSec)

cont'd

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Table 1-1. 626-PA-6040 Technical Specifications (Page 2 of 2)

SELECTABLE THRESHOLDS:	
Low Limit -	50 to 599V rms
High Limit -	51 to 600V rms
Voltage Sensitivity (Increases and Decreases) -	2 to 60V rms
Impulse Limits -	50 to 4000V pk
Frequency Sensitivity -	1 to 9Hz (in 1Hz increm.)
GRAPHIC PRINTOUTS	
VERTICAL RESOLUTION	2V on 250 volt range 4V on 500 volt range 8V on 1000 volt range
GRAPHICS DATA ACCURACY:	
Line Voltage -	±5% of reading ±2.5% of F.S.
Impulses -	For >100V pk, >10 uSec, ±10% of reading ±10% of F.S. Typically -6dB @ 2 uSec.
Graph Full Scale -	250V pk, 500V pk, 1000V pk, or Off (No Graph)
Selectable Graph Size -	2" or 4"

1.6 STANDARD ACCESSORIES

(The model number refers to your particular 6040 plug-in model: 6040-1 or 6040-2.)

Model #	Part #	Quantity	Description
626-PA-6040-1 (Barrier-type terminal strip inputs)	TM-112975-G3/G4 V1	1	Operator's Manual
	(NO AC CABLES REQUIRED)		
626-PA-6040-2 (Connector inputs and mating cables)	TM-112975-G3/G4 V2	1	Operator's Manual
	110480	3	AC Cables

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1.6.1 Required Accessories

The required accessories for operating the 6040 plug-in (Model 6040-1 or 6040-2) are a Series 626 Mainframe and a Model 626GP Graphics Printer or a compatible such as the Epson FX-100+ or H.P. Thinkjet (if graphic printouts are required.) Printout sizes are selectable in 2x2 or 4x4 inches. (The 2x2 printouts show slightly less detail than the 4x4 printouts but print three-times as fast.)

NOTE

See Appendix A for the configuration and cable wiring if using an Epson FX-100+ or H.P. Thinkjet printer.

1.7 OPTIONAL ACCESSORIES

(For both models.)

Part #	Quantity	Description
TM-112975-G3/G4 Vol. 2	1	Service (Maintenance) Manual

You can receive the Volume 2 manual by filling out and returning the Control Sheet in your Series 626 Operating manual. Note: You must indicate the serial number of your plug-in to receive the Volume 2 manual.

1.8 FACTORY REPAIR

When factory repair is required, proceed as follows:

1. Contact Dranetz Customer Service Department to obtain an authorization number for factory repair:

   Telephone No: (201) 287-3680 TWX: (710) 997-9553

   FAX: (201) 248-9240 Telex: 499-7808

   Cable: DRANETZ

2. Fill out the REPAIR/SERVICE ORDER form enclosed in the Series 626 Operating manual. Ship it along with the malfunctioning equipment to the Dranetz Customer Service Department.

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SECTION II
INSTALLATION AND OPERATION

2.1 GENERAL

This section contains the installation, programming, and operating instructions for the 6040 plug-in (Models -1 and -2).

2.2 LOAD RATINGS

The Series 626 Mainframe has an upper limit of the combined total rating of its installed modules. This rating is 20 units. The individual modules (existing as of this printing) have the following load ratings:

Table 2-1. Load Ratings

Plug-in	Load Rating	Plug-in	Load Rating
626-PA-6001	2 Units	626-PA-60012A	3 Units
626-PA-6001		626-PA-6013	2 Units
with Extra		626-PA-6014	1 Unit
Option Board	3 Units	626-PA-6015	4 Units
626-PA-6002	2 Units	626-PA-6018	4 Units
626-PA-6003	4 Units	626-PA-6020	4 Units
626-PA-6005	2 Units	626-PA-6024A	4 Units
626-PA-6006	2 Units	626-PA-6024B	4 Units
626-PA-6007	1 Unit	626-PA-6025	4 Units
626-PA-6008	2 Units	626-PA-6030	6 Units
626-PA-6009	4 Units	626-PA-6037	1 Unit
626-PA-6011	1 Unit	626-PA-6038	1 Unit
626-PA-6012	2 Units	626-PA-6040	6 Units

NOTE

When selecting modules for installation into any Series 626 Mainframe, verify that the sum of the load ratings of the installed modules DOES NOT exceed 20 units.

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2.3 INSTALLATION

(Note: Two adjacent slots are required by the 6040 plug-in.)

To install the 6040 plug-in into the Mainframe:

WARNING

Be sure that the Series 626 Mainframe and all of the power connected to its plug-in modules are first turned OFF before proceeding with any installation.

(1) Remove the 6040 plug-in from its packaging.

(2) Position the top and bottom front corners of the plug-in module into the upper and lower tracks of two adjacent slot positions at the rear of the Series 626 Mainframe.

(3) Carefully slide the module into the Mainframe until it is firmly in position.

(4) Tighten the top and bottom captive screws in order to secure the module to the Mainframe.

2.4 CONNECTING POWER SOURCE TO MODULE

CAUTION

To avoid damage, DO NOT apply ac voltages in excess of 600V rms to any ac phase input (A, B, or C) of the 6040 plug-in.

WARNING

Because of possible shock or fire hazards, connection of this instrument should be performed in compliance with the National Electric Code (ANSI C1), or any other requirements, or both, which may be applicable to the user.

Installation, operation, and maintenance should only be performed by qualified personnel. Your qualifications for doing so should be self-determined.

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2.4.1 Connection Procedure

The 6040 plug-in is equipped with either a barrier block connector (Model 6040-1) or three rear panel AC connectors (Model 6040-2). Inputs are marked as phases A, B, and C. For the barrier block connectors, the terminals must be wired in accordance with the rear panel connector markings: AC Hot, AC Neutral, and instrument safety ground (refer to step 5 of Subsection 2.5).

(1) Turn off the Series 626 by inserting the key into the FUNCTION key switch and setting the switch to "OFF." Unplug the Mainframe from its power source.

(2) Turn off the power source that is going to be monitored by the plug-in.

(3) Make all connections to the 6040 plug-in first.

WARNING

If you are using a Model 6040-1, be sure to replace the barrier block cover after making the connections. DO NOT proceed until you have done so.

(4) Make the desired connections to the power source that is going to be monitored.

(5) Plug the Mainframe back into the power source. Turn on the Series 626 by turning the FUNCTION Key Switch to "OPERATE."

(6) Turn on the power source that is going to be monitored.

2.4.2 Circuit Applications

WARNING

Conductors connecting to measurement points should be approved for the specific use. When connected to branch circuits of 20 amperes or less, the minimum flexible cord size is No. 18 (1 mm square). For branch circuits with higher ampacity, refer to National Electric Code (ANSI CI-1975), paragraphs 240-4 and 250-95. Special consideration of ground may be required. (Refer to Article 250 of above reference if in doubt.) Outside of the United States, consult the applicable safety standards.

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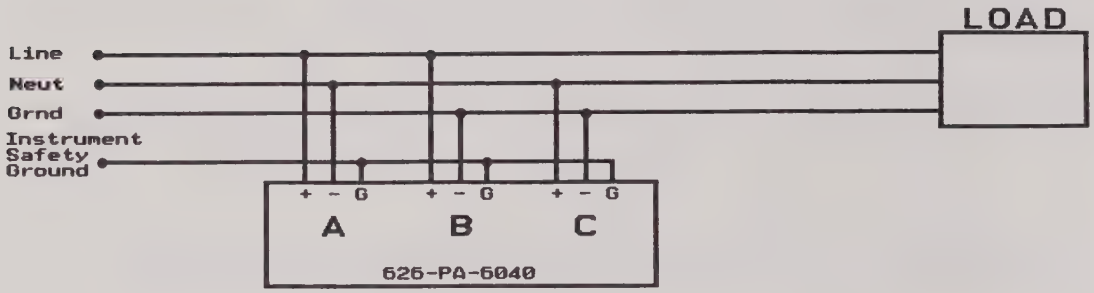
The Three-phase AC monitor for 370 to 450 Hz may be used by itself for Normal Mode/Common Mode analysis of 1-phase lines (illustrated in Figure 2-1), for analysis of up to three separate ac signals (illustrated in Figure 2-2), or for analysis of 3-phase delta lines (illustrated in Figure 2-3).



Readings:

Channel A: Line-Neutral
Channel B: Line-Ground
Channel C: Neutral-Ground

Figure 2-1. One-Phase Normal Mode/Common Mode

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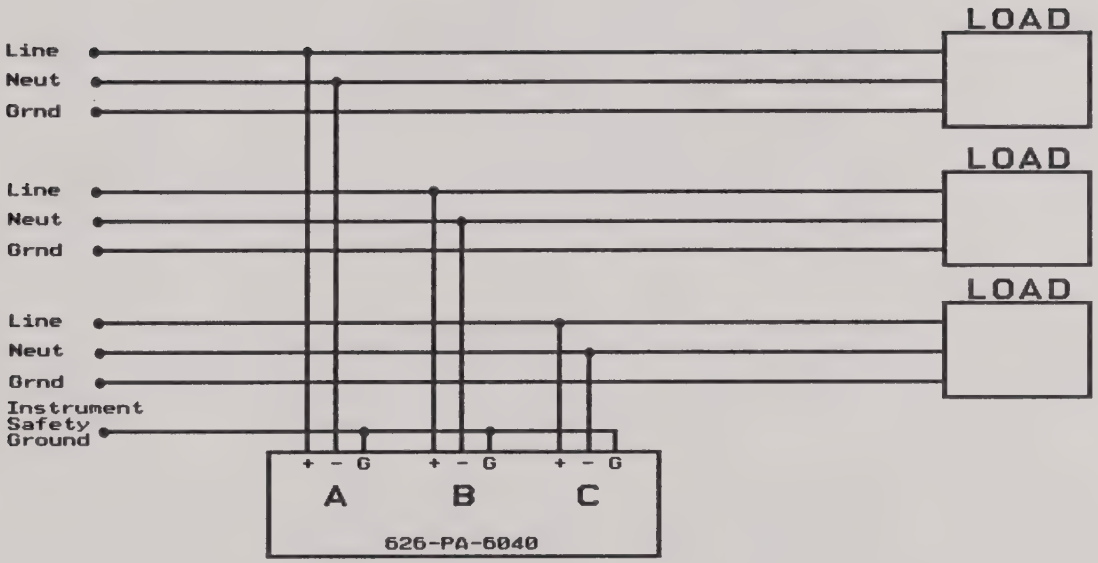

Figure 2-2. Three Separate AC Lines

Notes:

1. All channels are monitored independently.
2. All line frequencies must be the same.
3. All three channels will have the same program setup.

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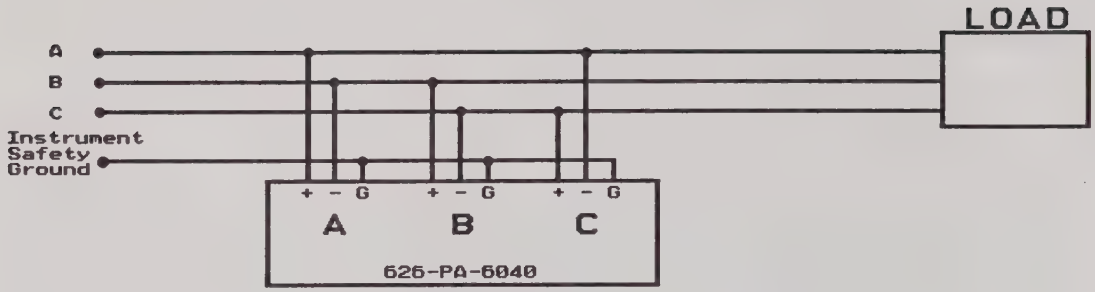

Figure 2-3. Three-Phase Delta

Notes:

1. Delta may be grounded or ungrounded.

2. Set the 6040 plug-in to monitor line-to-line voltage. For Example: For a 240 volt delta, set the High and Low limits to either side of 240V ac.

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2.5 MONITORING GUIDELINES

Proper monitoring and analysis of ac voltage disturbances requires careful attention to the method of connection between the Series 626 Mainframe and the monitored circuit. To obtain the most accurate and relevant voltage monitoring data, follow these suggested guidelines:

(1) To minimize spurious impulse transients and interchannel coupling, always use the Dranetz cables supplied with the Mainframe. If you have a Model 6040-1 (barrier-type terminal trip), use a cable composed of twisted-pair wires for each input channel.

(2) Cable length should be minimized--preferably less than 8 feet from the Mainframe to the circuit connection point. This minimizes amplitude variation of impulse transients.

(3) If monitoring a power line connected to critical, sensitive load equipment, the cable should be connected to the power line as close as possible to the load. For three-phase loads, the plug-in should be connected in the same way as the load equipment, that is, Phase-to-Phase or Phase-to-Neutral.

(4) Use of instrument-grade Potential Transformers for monitoring impulses on high voltage power lines is not recommended. The limited frequency response of most Potential Transformers may result in substantial variation of impulse amplitude.

(5) The Mainframe is designed to operate from disturbed power lines, therefore, its power supply may be connected to the same power line that is being monitored. However, be aware that if you do this, the transients you are trying to detect may be suppressed by the Mainframe's power supply. This is because the ground terminals of the plug-in modules are connected internally to the safety grounding conductor in the Mainframes's power plug. **To avoid this problem, we recommend that you power the Mainframe from a different line than the one you are monitoring.**

2.6 OPERATING THE 6040 PLUG-IN

The following subsections contain information on the Mainframe's operating controls and indicators used by the plug-in along with its programming procedure.

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2.6.1 Operating Controls and Indicators

The functions of the Mainframe operating controls and indicators associated with 6040 plug-in operation are described in Table 2-3. Figure 2-4 illustrates the typical front panel controls on a Series 626 associated with a 6040 plug-in. Refer to Volume 1 of the Mainframe manual for an overall command description.

Table 2-3. 6040 Plug-in Operating Controls

ITEM	FUNCTION
Numerical Keys*	Used to enter numerical values for the various functions.
[LO LIMIT] Key	When pressed, enables numerical keyboard to program Low limit voltage.
[HI LIMIT] Key	When pressed, enables numerical keyboard to program High limit voltage.
[SENS] Key	When pressed, enables numerical keyboard to program voltage sensitivity threshold.
[IMP SENS] Key	When pressed, enables numerical keyboard to program frequency sensitivity threshold.
[F SENS] Key	When pressed, enables numerical keyboard to program frequency sensitivity value.
[ENTER] Key	When pressed, transfers the entered numerical value into the plug-in's memory.
[CLEAR ENTRY] Key	When pressed, cancels the current numerical sequence being entered.
[RANGE] Key	When pressed, enables numerical keyboard to program the full scale range of the graphs produced by an attached printer; also, allows selection of 2" or 4" graph size.
[PROG] Button*	Produces Prog. Summary printout when pressed.
[DATA] Button	Produces Data Summary printout when pressed.
[PRESET] Button	With FUNCTION key switch set to "PROGRAM," pressing [PRESET] recalls the non-volatile "Factory Preset" program for the last channel pressed.
* -"Key" and "Keyboard" represent the red, green, and yellow keys; "Button" represents the black selector buttons.	

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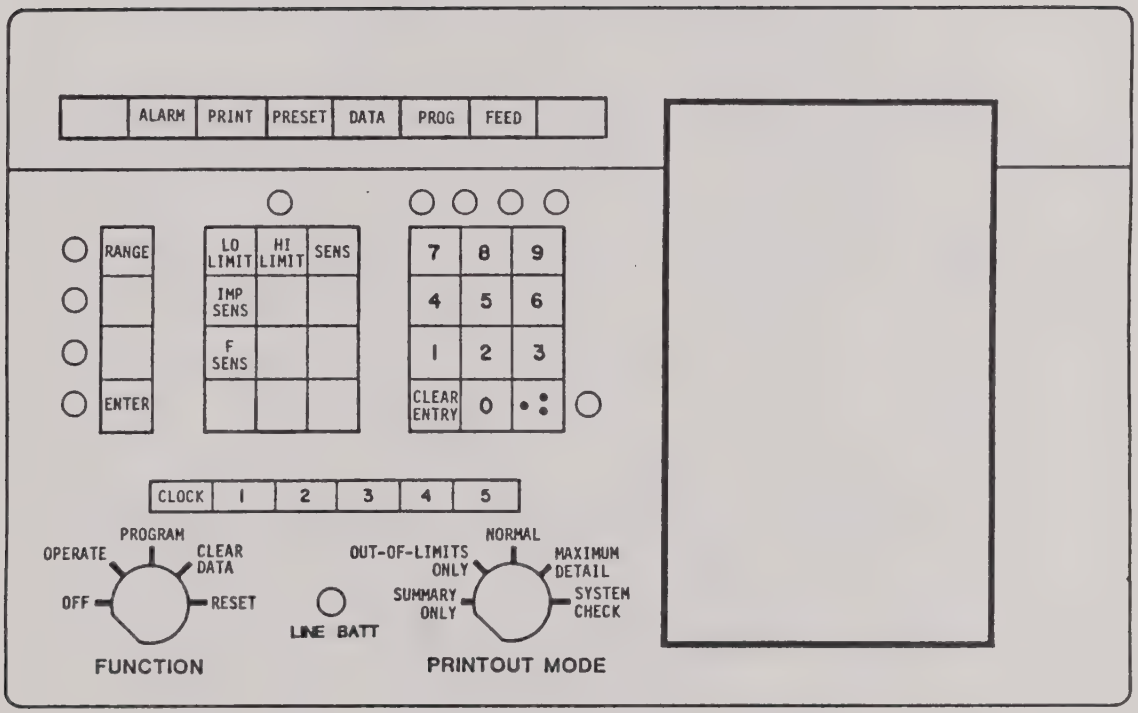

Figure 2-4. Series 626 Controls used by the 6040 Plug-in

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2.6.2 Programming Procedure

The easiest and clearest way to learn the programming of the 6040 plug-in is through an illustrated example.

Assume it is desired to program:

-- A graph size of 2 inches,
-- a full scale graph range of 500V,
-- a high limit of 229V,
-- a low limit of 187V,
-- a voltage sensitivity of 5V,
-- a frequency sensitivity of 2Hz,
-- and an impulse sensitivity of 100V.

The voltage and frequency sensitivities set the deviation from the present value, above or below which a detected value produces a recorded disturbance.

For impulse measurements, the sensitivity corresponds to the absolute threshold, so that for an impulse sensitivity of 50 volts, a disturbance is recorded when the impulse amplitude rises above 50 volts.

NOTES

1) It is recommended that the high and low limits be set to at least 3V (respectively) from the nominal voltage being measured. For example, if monitoring 220V, the high limit should be set to at least 223V and the low limit to at most 217V.

2) It is also recommended that the sensitivity be set to 2% or higher of the nominal input voltage.

For this example, program the 6040 plug-in as follows:

(1) Set the FUNCTION key switch to "PROGRAM"; set the PRINTOUT MODE key switch to "NORMAL."

(2) Since the 6040 plug-in occupies two slots, push the lower of the two black buttons of the two slots being occupied (for example, [2], when slots 2 and 3 are occupied.) Note that a Program Summary for that channel is immediately printed.

(3) The cueing indicator above the left bank of keys lights, indicating that [RANGE] should now be pressed.

(4) Press [RANGE]. A printout such as the one on the top of the next page is printed. Press [1] on the keyboard to select the 2" graph size and then press [ENTER].

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The menu mentioned in step (4) appears as follows:

626	626A,G,R,ARA
2 = 4"	SELECT GRAPH SIZE
1 = 2"	0 = NO GRAPH
0 = NO GRAPH	1 = 2"
SELECT GRAPH SIZE	2 = 4"

(5) The following menu is then printed:

626	626A,G,R,ARA
3 = 1000 VPK	SELECT FULL SCALE
2 = 500 VPK	FOR GRAPH
1 = 250 VPK	0 = NO GRAPH
0 = NO GRAPH	1 = 250 VPK
FOR GRAPH	2 = 500 VPK
SELECT FULL SCALE	3 = 1000 VPK

(6) Press [2] and [ENTER] to select the 500V range.

(7) Press [HI LIMIT]. Program the high limit value (229) using the keyboard to type the numerical entries.*

NOTE

The instrument is designed to detect an invalid entry and to automatically shift high and low limits.

(8) When the ENTER LED lights, press [ENTER]. The programmed high limit is echoed back on the printout and the ENTER LED will go out.

(9) Press [LO LIMIT] and program the low limit value (187) using the keyboard to type the numerical entries, followed by [ENTER]. The programmed low limit is echoed back on the printout and the ENTER LED will go out.

(10) Press [SENS] and program the voltage sensitivity (005) using the keyboard to type the numerical entries, followed by [ENTER]. The programmed voltage sensitivity is echoed back on the printout and the ENTER LED will go out.

* -If an incorrect entry is made, press [CLEAR ENTRY] and the current sequence of numerical entries will be erased, allowing the correct sequence to be retyped.

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(11) Press [F SENS] and program the frequency sensitivity (2.0), using the numerical keyboard to type the numerical entries, followed by [ENTER]. The programmed frequency sensitivity is echoed back on the printout and the ENTER LED will go out.

(12) Press [IMP SENS] and program the impulse sensitivity (0100), using the numerical keyboard to type the numerical entries, followed by [ENTER]. The programmed impulse sensitivity is echoed back on the printout and the ENTER LED will go out.

(13) Press [PROG] to obtain a Program Summary printout for verification.

The completed program printout should appear as follows:

626

```
IMPULSE SENS 0100V
FREQ SENS   2.0 HZ
VOLTAGE SENS 005 V
V LOW LIMIT  187 V
V HIGH LIMIT 229 V
GRAPH F.S. 500 VPK
GRAPH SIZE 2"
   626-PA-6040
      CH 2
PROGRAM SUMMARY
```

626A,G,R,ARA

```
PROGRAM SUMMARY
      CH 2
   626-PA-6040
GRAPH SIZE 2"
GRAPH F.S. 500 VPK
V HIGH LIMIT 229 V
V LOW LIMIT  187 V
VOLTAGE SENS 005 V
FREQ SENS   2.0 HZ
IMPULSE SENS 0100V
```

(14) When the plug-in program is completed, you can proceed to program another module (by pressing another channel number), or you can place the instrument on-line by setting the FUNCTION key switch to "OPERATE." While on-line, the Program Summary of the current program may be obtained by simply pressing [PROG].

2.6.3 Selecting the Factory Preset Program

A factory preset program is built into your Series 626 Mainframe. This program lets you use the PRESET command to recall the factory preset setups from the 6040 plug-in's memory.

(1) To select the program stored in the Mainframe's permanent memory, set the FUNCTION key switch to "PROGRAM" and press the desired channel number. The last Operator-set program will be printed as illustrated on the next page.

(2) Press [PRESET] to recall the Factory Preset program. An example of this sequence appears on the next page. In the example, the differences in the Operator's and Factory Preset programs are listed at the top of the next page.

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	Operator's	Factory Preset
Impulse Sensitivity:	100V	200V
Frequency Sensitivity:	2Hz	5Hz
Graph Size	2"	4"

626

```
IMPULSE SENS 0200V
FREQ SENS   5.0 HZ
VOLTAGE SENS  005V
V LOW LIMIT  187 V
V HIGH LIMIT 229 V
GRAPH F.S.  500VPK
GRAPH SIZE 4"
   626-PA-6040
       CH 2
 PROGRAM SUMMARY
```

```
IMPULSE SENS 0100V
FREQ SENS   2.0 HZ
VOLTAGE SENS  005V
V LOW LIMIT  187 V
V HIGH LIMIT 229 V
GRAPH F.S.  500VPK
GRAPH SIZE 2"
   626-PA-6040
       CH 2
 PROGRAM SUMMARY
```

OPERATOR'S MANUAL

626A,G,R,ARA

```
PROGRAM SUMMARY
      CH 2
  626-PA-6040
GRAPH SIZE 2"
GRAPH F.S.  500VPK
V HIGH LIMIT 229 V
V LOW LIMIT  187 V
VOLTAGE SENS  005V
FREQ SENS   2.0 HZ
IMPULSE SENS 0100V
```

```
PROGRAM SUMMARY
      CH 2
  626-PA-6040
GRAPH SIZE 4"
GRAPH F.S.  500VPK
V HIGH LIMIT 229 V
V LOW LIMIT  187 V
VOLTAGE SENS  005V
FREQ SENS   5.0 HZ
IMPULSE SENS 0200V
```

2.7 DESCRIPTION OF DATA PRINTOUTS

When any of the disturbances described below is detected by the 6040 plug-in, it is recorded and displayed in the listed manner. In addition, if a Graphics Printer (or compatible) is connected, graphical disturbance printouts are also obtained. The printouts of Subsections 2.7.1 through 2.7.6 represent printouts that would be obtained by either the Mainframe's printer or by a connected Graphics Printer. If a Graphics Printer were connected, waveforms of the disturbances would also be displayed (in 2" or 4" sizes, as desired).

NOTES

If a Graphics Printer (or compatible) is connected, you should disable the Mainframe's printer, since its display is repetitive with the Graphics Printer's display. Pressing [PRINT] will disable the Mainframe's printer; pressing [PRINT] again re-enables it.

In the disturbance printouts of subsections 2.7.1 thru 2.7.5, voltage levels are based on waveform rms values.

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2.7.1 Overvoltage

An overvoltage condition exists when the monitored power line voltage exceeds the user-specified upper limit for more than 2.55 seconds. An overvoltage condition is indicated by a printout such as the following:

```
4B  HI  09:46:07.11
```

where 4 is the channel number, B is the phase, and time is given in hours, minutes, and seconds (to the 0.01 second resolution).

When the line voltage returns to normal (within limits), a printout such as the following occurs:

	626	626A,G,R,ARA	
↑	4B NOR 09:46:15.20 235.6 V MAX	235.6 V MAX 4B NOR 09:46:15.20	↓

The printout indicates the time when normal voltage was restored and the highest voltage reached during the overvoltage interval.

2.7.2 Undervoltage

An undervoltage condition exists when the monitored power line voltage remains below the user-specified lower limit for more than 2.55 seconds. An undervoltage condition is indicated by a printout such as the following:

```
4C  LO  09:46:15.20
```

When the line voltage returns to normal (within limits), a printout such as the following occurs (see next page):

	626	626A,G,R,ARA	
↑	4C NOR 09:46:18.45 198.4 V MIN	198.4 V MIN 4C NOR 09:46:18.45	↓

The printout indicates the time when normal voltage was restored and the lowest voltage reached during the undervoltage condition.

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2.7.3 Voltage Change

A voltage change printout is triggered when the line voltage changes more than a pre-selected amount from the last printed value. The voltage change sensitivity is a user-selected integer voltage between 2 and 60 volts. The following example shows an increase to 216.4 volts followed by a decrease to 214.2 volts at the times shown (assume 2V sensitivity).

	626	626A,G,R,ARA
↑	2A DEC 01:02:35.08 214.2 V	216.4 V 2A INC 01:02:34.56
	2A INC 01:02:34.56 216.4 V	214.2 V 2A DEC 01:02:35.08 ↓

2.7.4 Voltage Surge

A Voltage Surge is defined as a line voltage which increases through a user-selected upper limit and then returns to an in-tolerance condition in less than 2.56 seconds. When a surge begins, its starting time is printed as follows:

```
4B   HI  09:45:33.15
```

When the line voltage returns to a normal level following a Surge condition, a message such as the following is printed:

	626	626A,G,R,ARA
↑	4B NOR 09:45:33.38 228.2 V MAX SURGE 0.23 SEC	SURGE 0.23 SEC 228.2 V MAX 4B NOR 09:45:33.38 ↓

The printout indicates the time when the voltage returned to normal (within limits), as well as the highest voltage reached and the surge duration.

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2.7.5 Voltage Sag

A voltage Sag is defined as a line voltage that decreases below the user-selected lower limit and then returns to an in-tolerance condition in less than 2.56 seconds. Sag printouts take the same form as surge printouts, with the terms SAG replacing SURGE, MIN replacing MAX, and LO replacing HI. When a sag begins, its starting time is printed as follows:

```
4B   LO  09:45:34.25
```

When the line voltage returns to a normal level following a Sag condition, a message such as the following is printed:

	626	626A,G,R,ARA	
↑	4B NOR 09:45:34.40 199.2 V MIN SAG 0.26 SEC	SAG 0.26 SEC 199.2 V MIN 4B NOR 09:45:34.40	↓

NOTE

Voltage inputs of less than 25V rms will be printed as 0.0V by the 6040 plug-in.

2.7.6 Impulses

"Impulse" disturbances represent any line perturbation which contains frequency components in the 2.5 to 500 kHz range. An impulse-type disturbance produces a printout such as the following:

	626	626A,G,R,ARA	
↑	2A IMP 10:12:13.45 0139 V, 0010 US	0139 V, 0010 US 2A IMP 10:12:13.45	↓

The printout indicates that an impulse which deviated from normal line voltage by 139 volts, peak, and with a 10 microsecond duration, was detected on phase A of Channel 2 at the time shown. The impulse magnitude is measured with respect to the instantaneous point on the power frequency sine wave where it occurs.

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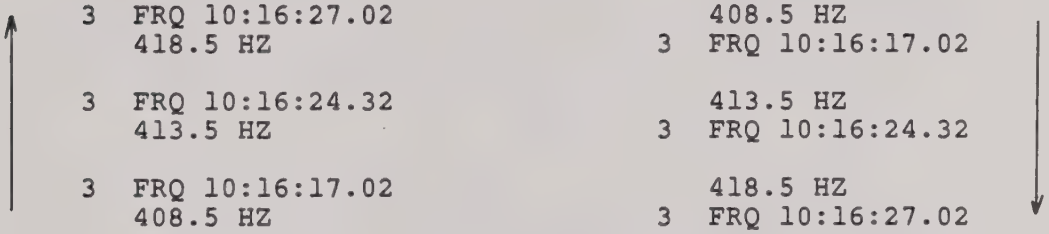
2.7.7 Frequency Change

A frequency change printout is triggered whenever the line frequency changes by more than a pre-selected amount from the last printed value. The frequency change sensitivity is a user-selected value between 1 and 9 Hz (in 1Hz increments). The following example shows several frequency change printouts (assume a frequency sensitivity of 5Hz).



NOTE

When using a Graphics Printer, a frequency change disturbance will not cause a corresponding graph to be printed.

2.8 DESCRIPTION OF GRAPHIC PRINTOUTS

Note: Refer to the Graphics Printer Operator's manual or your Epson FX-100+ or Hewlett-Packard Thinkjet manual for complete information on these printers.

With the Model 626GP Graphics Printer attached, graphs are plotted for each disturbance as long as there is sufficient memory to store the event.

NOTE

If two or more disturbances on the same phase are recorded with the same time signature, only one graph is entered.

Typically, the memory of the 6040 plug-in can hold between 8 and 22 graphs. When the graphic memory is full, the 6040 plug-in continues monitoring but only prints the text of the disturbance, not the graph. Graphical printouts resume when there is sufficient free memory.

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2.9 VARIOUS PRINTOUT MODES

The setting of the PRINTOUT MODE key switch determines the amount of detail which is printed from any disturbance. The further clockwise the key is turned, up to the SYSTEM CHECK position, the more detail is printed regarding a disturbance. Below is a list of the four key switch positions and the amount of detail printed when the PRINTOUT MODE key is in each position.

SUMMARY ONLY

The Series 626 printer and Graphics Printer are both inhibited. All data acquired by the 6040 plug-in is stored in the Series 626's daily accumulator. A daily summary is printed at midnight (Series 626 time), or when the black [DATA] button is pressed.

OUT-OF-LIMITS-ONLY

Disturbance data is ONLY printed when the disturbance is recorded as out-of-limits (the averaged sensitivity deviations such as voltage and frequency changes are not printed).

NORMAL

A moderately detailed printout of any disturbances recorded by the 6040 plug-in is printed.

MAXIMUM DETAIL

A highly detailed printout of any disturbances recorded by the 6040 plug-in is printed. When printing graphs, all three phases are graphed for each disturbance.

2.9.1 Example Printouts using a Graphics Printer

The printouts of the following subsections illustrate some of the various printouts obtained when disturbances are recorded by the 6040 plug-in. The waveforms were printed by a Graphics Printer. It is assumed that the limits were programmed as follows:

Graph F.S: 500V pk (Size: 4")	Voltage Sensitivity: 5V
Voltage High Limit: 132V	Frequency Sensitivity: 5.0Hz
Voltage Low Limit: 108V	Impulse Sensitivity: 200V

NOTE

Disturbances which occur while the PRINTOUT MODE switch is in the "SUMMARY ONLY" position do not generate individual printouts, but are stored in the daily accumulator and are automatically printed each day at midnight (worst case event and number of occurrences in each category). This printout may also be triggered manually by pressing the [DATA] button.

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2.9.1.1 Impulse Disturbance Printout

Figure 2-5 below is a printout of an Impulse (spike) of 340 volts which lasted 11 microseconds. The printout would be the same in the Out-Of-Limits Only, Normal, and Maximum Detail Modes. If a Graphics Printer were not used, the Mainframe's printer would simply print:

626	626A,G,R,ARA
1A IMP 10:54:51.85	0340 V, 0011 uS
0340 V, 0011 uS	1A IMP 10:54:51.85

However, with a Graphics Printer installed, not only is the text printed but the waveform as well:

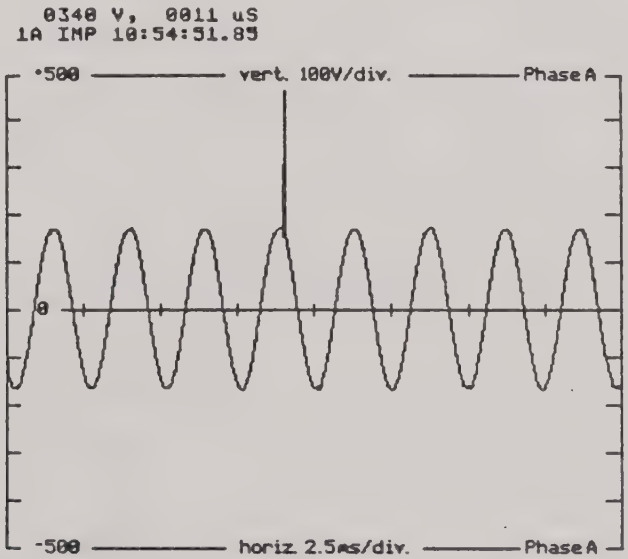

Figure 2-5. Impulse Waveform Printed by the Model 626GP

2.9.1.2 Surge Disturbance Printout

Figure 2-6 is a printout of a Surge which lasted 0.06 seconds and reached a maximum of 142.2 volts. The printout of Figure 2-6 would occur in the Out-of-Limits Only Mode--a waveform is printed when the voltage goes out of limits and another is printed when the voltage returns to normal (within limits). If the PRINTOUT MODE key switch were set to "NORMAL," every increase or decrease of the voltage (exceeding the 5V threshold) would also trigger a disturbance printout and a graph. If the PRINTOUT MODE key switch were set to "MAXIMUM DETAIL," all three phases (A, B & C) would be printed whenever a disturbance is detected (increases and decreases included).

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Without a Graphics Printer, the Mainframe's printer would print:

626	626A,G,R,ARA
1A NOR 13:28:33.31 142.6 V MAX SURGE 0.06 SEC	1A HI 13:28:33.25
1A HI 13:28:33.25	SURGE 0.06 SEC 142.2 V MAX 1A NOR 13:28:33.31

However, if a Graphics Printer were installed, the following would be printed (note that the waveform partially overlaps itself):

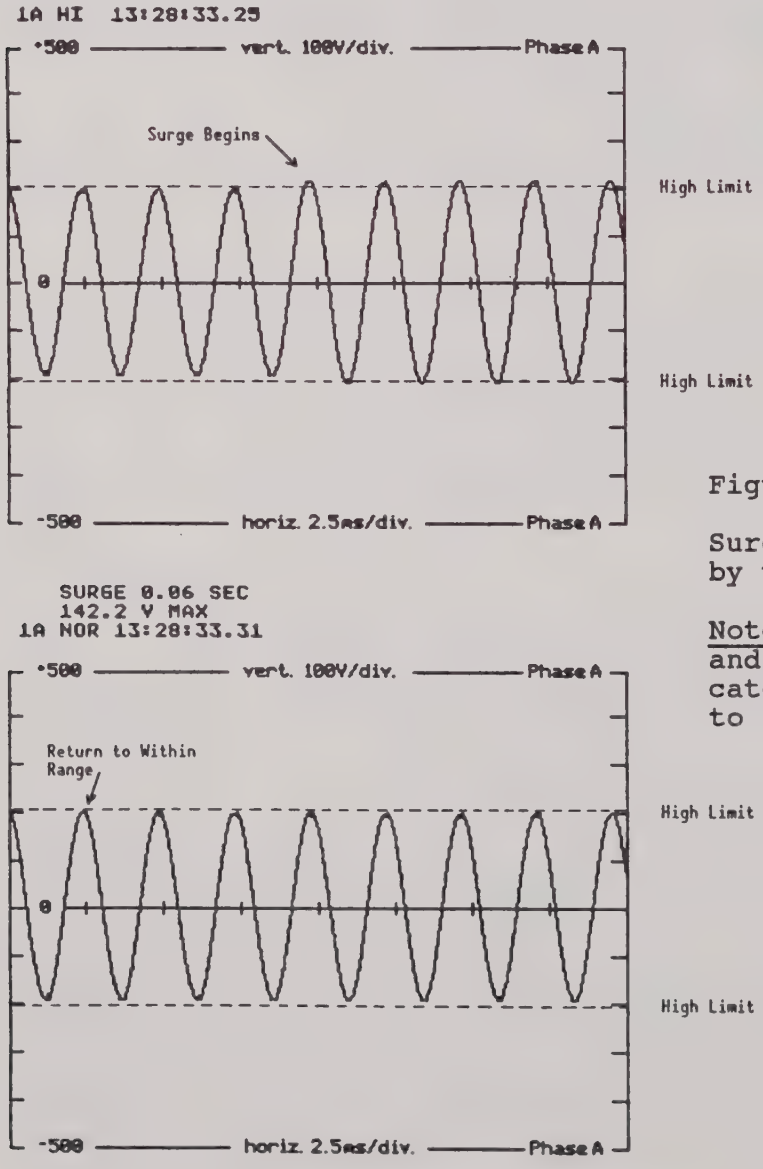

Figure 2-6.

Surge Waveform Printed by the Model 626GP

Note: The dashed lines and "High Limit" indicators are used here to illustrate a point.

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2.9.1.3 Overvoltage Disturbance Printout

Because an Overvoltage disturbance "HI" waveform is nearly identical to a Surge waveform, an example printout is not presented. The only difference in the text would be that the duration of the disturbance would be more than 2.55 seconds (by definition).

2.9.1.4 Sag Disturbance Printout

Figure 2-7 is a printout of a Sag which lasted 0.24 seconds and reached a minimum of 106.3 volts. The printout would occur in the Normal Mode--a waveform is printed when the voltage goes out of limits, each time it crosses the voltage sensitivity threshold of 5V, and finally when the voltage returns to within limits.

Without a Graphics Printer, the Mainframe's printer would print:

626	626A,G,R,ARA
1A NOR 13:23:31.45	1A LO 13:23:31.21
106.3 V MIN	
SAG 0.24 SEC	SAG 0.24 SEC
	106.3 V MIN
1A LO 13:23:31.21	1A NOR 13:23:31.45

However, if a Graphics Printer were installed, the graphs on the following page would be printed (note that the waveform partially overlaps itself).

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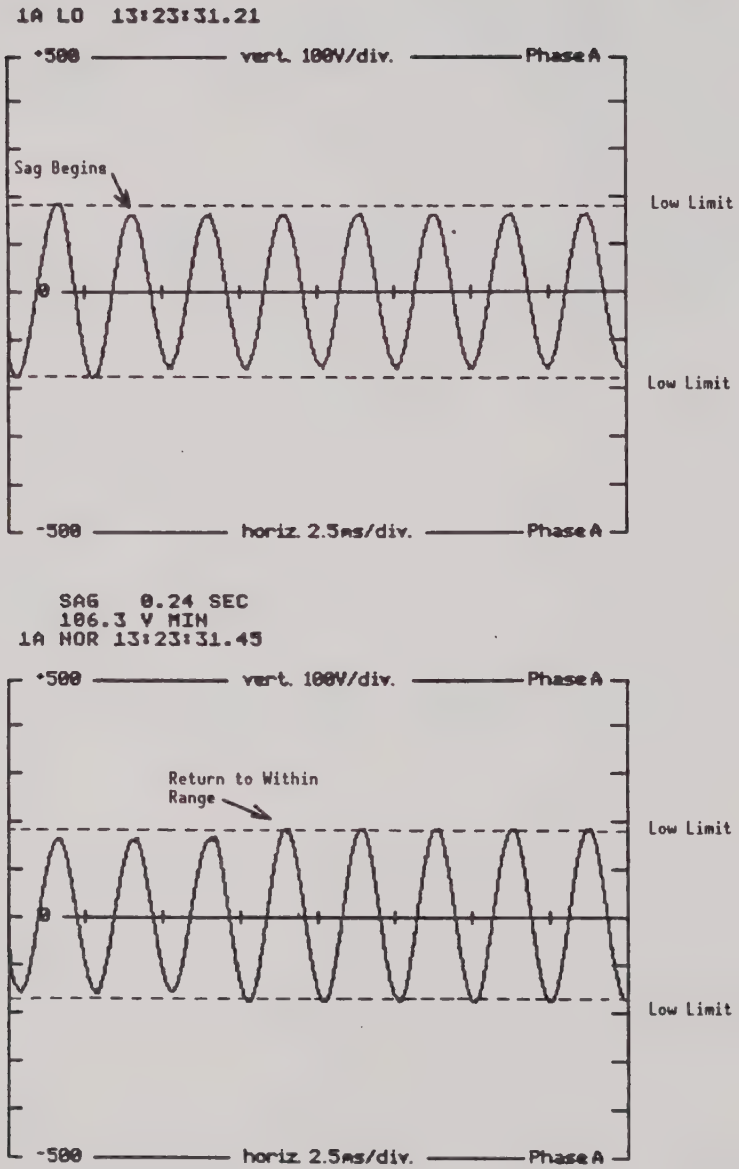

Note: The dashed lines and "Low Limit" indicators are used here to illustrate a point.

Figure 2-7. Sag Waveform Printed by the Model 626GP

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2.9.1.5 Undervoltage Disturbance Printout

Because an Undervoltage disturbance "LO" waveform is nearly identical to the Sag waveform, an example printout is not presented. The only difference in the text would be that the duration of the disturbance would be more than 2.55 seconds (by definition).

2.10 AUTOMATIC GRAPH SUPPRESSION

A graph will be suppressed (deleted) when the plug-in determines that the graph will contain no additional information other than that found in the previous graph. This eliminates the continuous printing of the same graph which would waste both time and paper.

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SECTION III
OPERATIONAL TEST

3.1 GENERAL

This section provides information for performing an operational test to verify that the 6040 plug-in is operating properly.

3.2 SYSTEM CHECK

(1) Turn the PRINTOUT MODE key momentarily to the "SYSTEM CHECK" position, and then back to "NORMAL."

When the PRINTOUT MODE key switch is turned to "SYSTEM CHECK," a source of precise signals is applied to the front-end circuitry of the 6040 plug-in. Any inputs connected at this time will be automatically disconnected during the system check period. Successful measurement of these signals verifies that the plug-in module is fully operational.

(2) Compare the actual displayed readings with those is subsection 3.2.1 below. If any readings are out of range, contact Dranetz Customer Service Department for further instructions (see subsection 1.8, FACTORY REPAIR.)

3.2.1 System Check Tolerances

AC Voltage ..... 196.0 to 204.0 Volts

Impulse Peak ..... 1800 to 2200 Volts

Impulse Duration ... 8 to 12 Microseconds

Frequency ..... 399.0 to 401.0 Hz

3.2.2 Example System Check Printout

The display on the following page illustrates an example System Check printout of a 6040 plug-in.

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626

```
******************

IMP- 2095V,   10US
AC VOLTS    200.0V
       PH C
IMP- 2085V,   10US
AC VOLTS    200.4V
       PH B
IMP- 2010V,   11US
AC VOLTS    201.6V
       PH A
FRQ    400.1 HZ
   626-PA-6040
       CH 1

06/30/88  14:53:25
***SYSTEM CHECK***
```

626A,G,R,ARA

```
***SYSTEM CHECK***
06/30/88  14:53:25

       CH 1
   626-PA-6040
FRQ    400.1 HZ
       PH A
AC VOLTS    201.6V
IMP- 2010V,   11US
       PH B
AC VOLTS    200.4V
IMP- 2085V,   10US
       PH C
AC VOLTS    200.0V
IMP- 2095V,   10US

******************
```

The above printout verifies the operational integrity of the 6040 plug-in for all three measurement phases (A, B, and C). The plug-in passes the System Check because all values are within the tolerances of Subsection 3.2.1.

3.3 CALIBRATION INTERVAL

The recommended calibration interval for this plug-in is once every 12 MONTHS.

We recommend that you return the plug-in to the factory for calibration. If you decide to do so, first contact Dranetz Customer Service Department to obtain an authorization number.

```
Telephone Number:  (201) 287-3680
    Telex Number:  499-7808
      TWX Number:  (710) 997-9553
      FAX Number:  (201) 248-9240
           Cable:  DRANETZ
```

Then fill out the Repair/Service Order form enclosed in this manual and ship it along with the equipment to Dranetz Customer Service Department. (If this form is missing, ask Dranetz Customer Service Department for a replacement.)

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APPENDIX A

USING AN EPSON FX-100+ or H.P. THINKJET PRINTER

A.1 GENERAL

The Series 626 Mainframe's front panel printer cannot produce graphic displays, therefore, another printer must be used when graphs are required. The 6040 plug-in is designed for use with the Dranetz Model 626GP Graphics Printer, however, it is also possible to use the 6040 plug-in with other compatible printers. For your convenience, the following subsections provide information on using the plug-in with the Epson FX-100+ and H.P. Thinkjet printers.

A.2 TRANSMISSION OF GRAPHICS DATA

Graphics data is only available at the Series 626 Mainframe's RS-232C port which is located on its rear panel (DCE Communications port, connector J2).

When transmitting graphics information, the data format is:

-- 8 bits,
-- no parity,
-- 2 stop bits, and
-- DTR handshaking.

NOTE

The Series 626 Mainframe's Communications Port must be set to at least 1200 baud, its default, in order to print graphs.

A.3 SETUP FOR AN EPSON FX-100+ PRINTER

When using an Epson FX-100+ printer, set the printer's DIP switches as follows:

DIP SWITCH 1		DIP SWITCH 2	
Pin 1	OFF	Pin 1	OFF
Pin 2	ON	Pin 2	ON
Pin 3	OFF	Pin 3	OFF
Pin 4	OFF	Pin 4	OFF
Pin 5	OFF		
Pin 6	ON		
Pin 7	ON		
Pin 8	ON		

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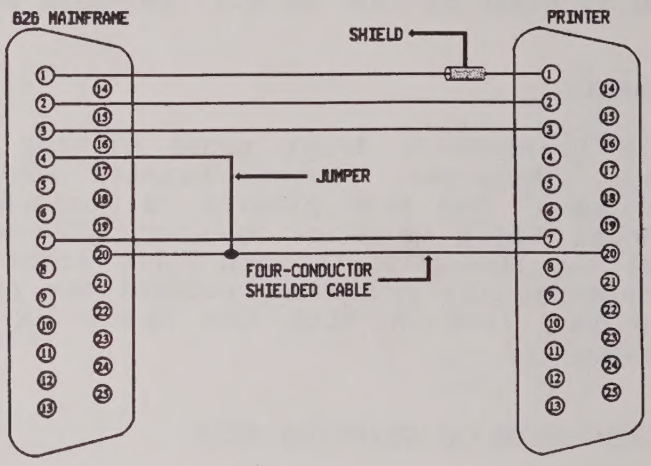
When making the cable, wire the connectors as follows:

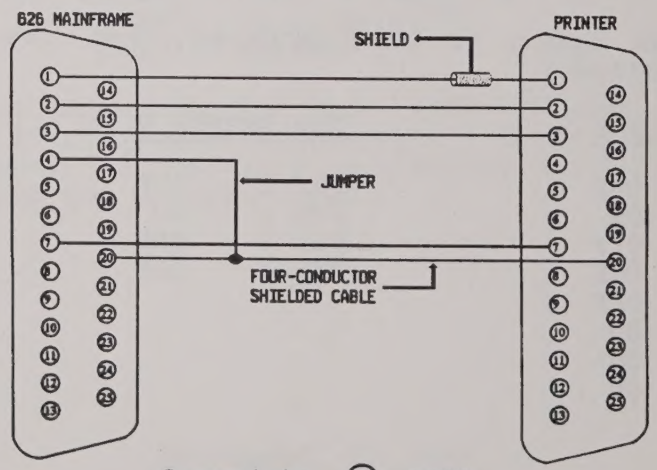


A.4 SETUP FOR AN H.P. THINKJET PRINTER

When using an H.P. Thinkjet printer, set the printer's DIP switches as follows:

DIP SWITCH 1		DIP SWITCH 2	
Pin 1	DOWN	Pin 1	UP
Pin 2	DOWN	Pin 2	DOWN
Pin 3	DOWN	Pin 3	DOWN
Pin 4	DOWN	Pin 4	UP
Pin 5	UP	Pin 5	UP
Pin 6	UP		
Pin 7	DOWN		
Pin 8	DOWN		

When making the cable, wire the connectors as follows:



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